Transport Phenomena in Field Effect Transistors

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Abstract

Tailoring therapies to individuals for personalized care can be safer and yield superior outcomes at lower doses for conditions such as diabetes, Alzheimers disease, or even certain cancers. However, widespread use of personalized care is currently limited by our inability to routinely measure pathology and detect biomarkers. Moreover, existing strategies require specialized facilities, and can be expensive and slow to perform. This has led to the development of a new portable detection tool known as a biological field effect transistor (Bio-FET). Very well-suited for biomarker measurements due their high charge sensitivity and direct signal transduction, Bio-FETs allow label-free measurements at physiological concentrations. Chemical reactants are injected at the top of a solution-well and diffuse through the well to bind with another chemical reactant immobilized on the well-floor. A resulting response curve allows for biomarker measurement and estimation of key parameters, such as binding affinities. A collection of mathematical models for FET experiments will be presented taking the form of a diffusion coupled to a nonlinear equation that describes the evolution of the reacting species concentration.